

US EPA ARCHIVE DOCUMENT



Overview of Brominated Flame Retardants



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Outline



- **What are BFRs?**
- **What is the basis for concern?**
- **How are they regulated?**



Historical Perspective



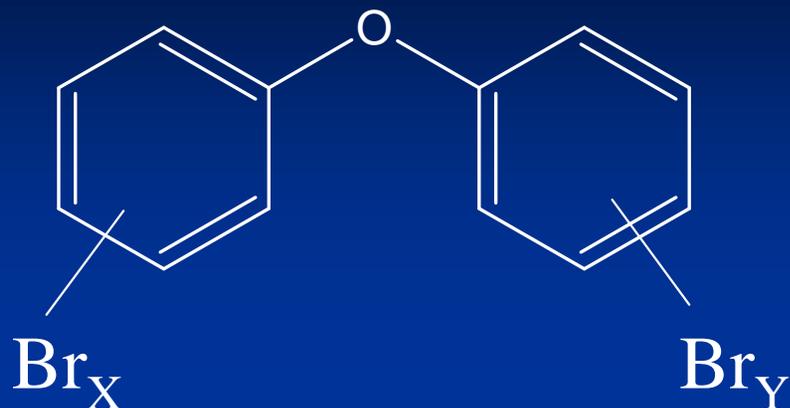
- Past: more products were wood and metal
- Now: numerous products are plastic or other petroleum-derived materials that are more flammable.
 - High standards for flame retardancy (esp., CA)
 - Additives needed to prevent plastics, foams, and other new materials from burning so fast.
- BFRs save lives (e.g., gives people more time to get out of the building)

BFRs: Dozens of Chemicals with Very Different Properties

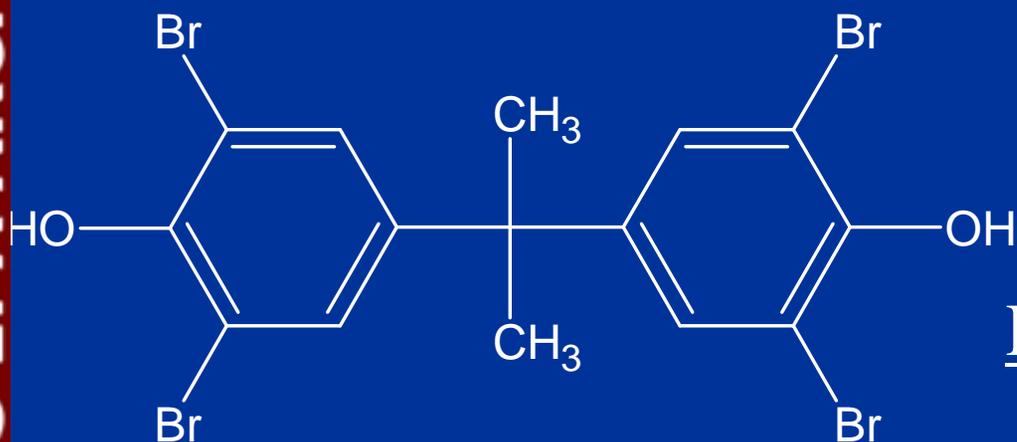


- Brominated
 - bisphenols
 - diphenylethers
 - cyclododecane
 - biphenyls (no longer produced)
 - phenols
 - phthalates
 - phenoxy ethanes
 - others

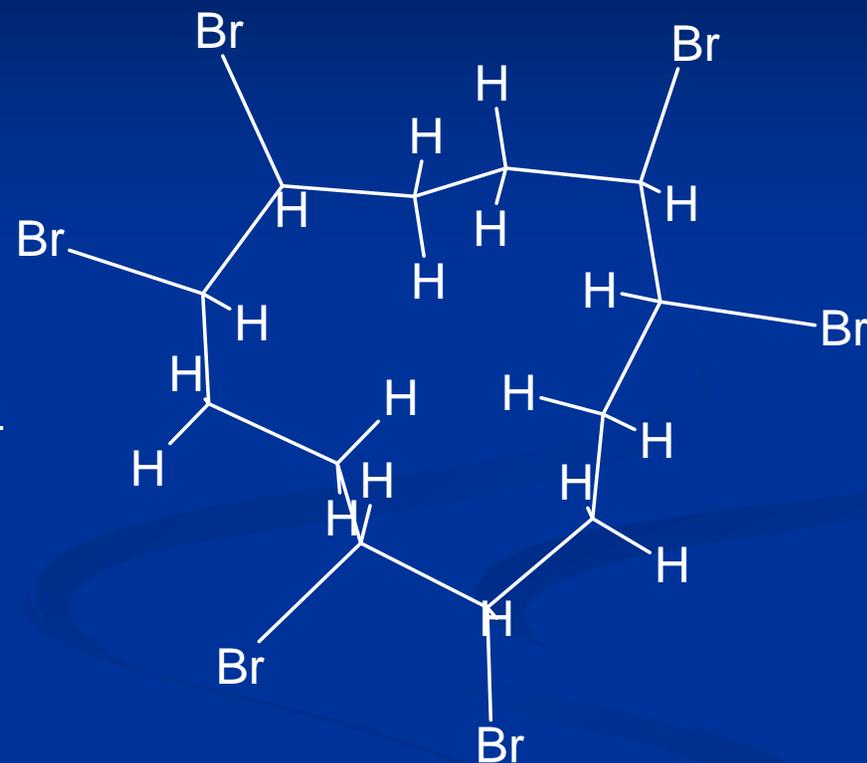
BFRs of Recent Concern



Polybrominated diphenylethers (PBDE)



Tetrabromobisphenol A (TBBPA)



Hexabromocyclododecane (HBCD)



Product Examples



Home

Couch, bed, chairs, television, stereo, hair dryer, iron, microwave oven, video, e-toys, carpets, curtains, lamp shades, water heater, wires, switches . . .



Office

Computer casings, circuit boards, wires and cables, carpets, copy and fax machines, printers, switches, sockets, plastic insulation, moulding fillers, laminates, epoxy resins, lighting . . .

Travel

Cars, trucks, buses, airplanes, tents . . .



Use in the Americas (2001 est.)



BFR	Millions of pounds per year	% of world's use
PentaBDE [†]	15.7	95*
OctaBDE	3.3	40
DecaBDE	54.0	44
TBBPA	39.7	15
HBCD [†]	6.2	17

BSEF, 2003

[†] Highly bioaccumulative

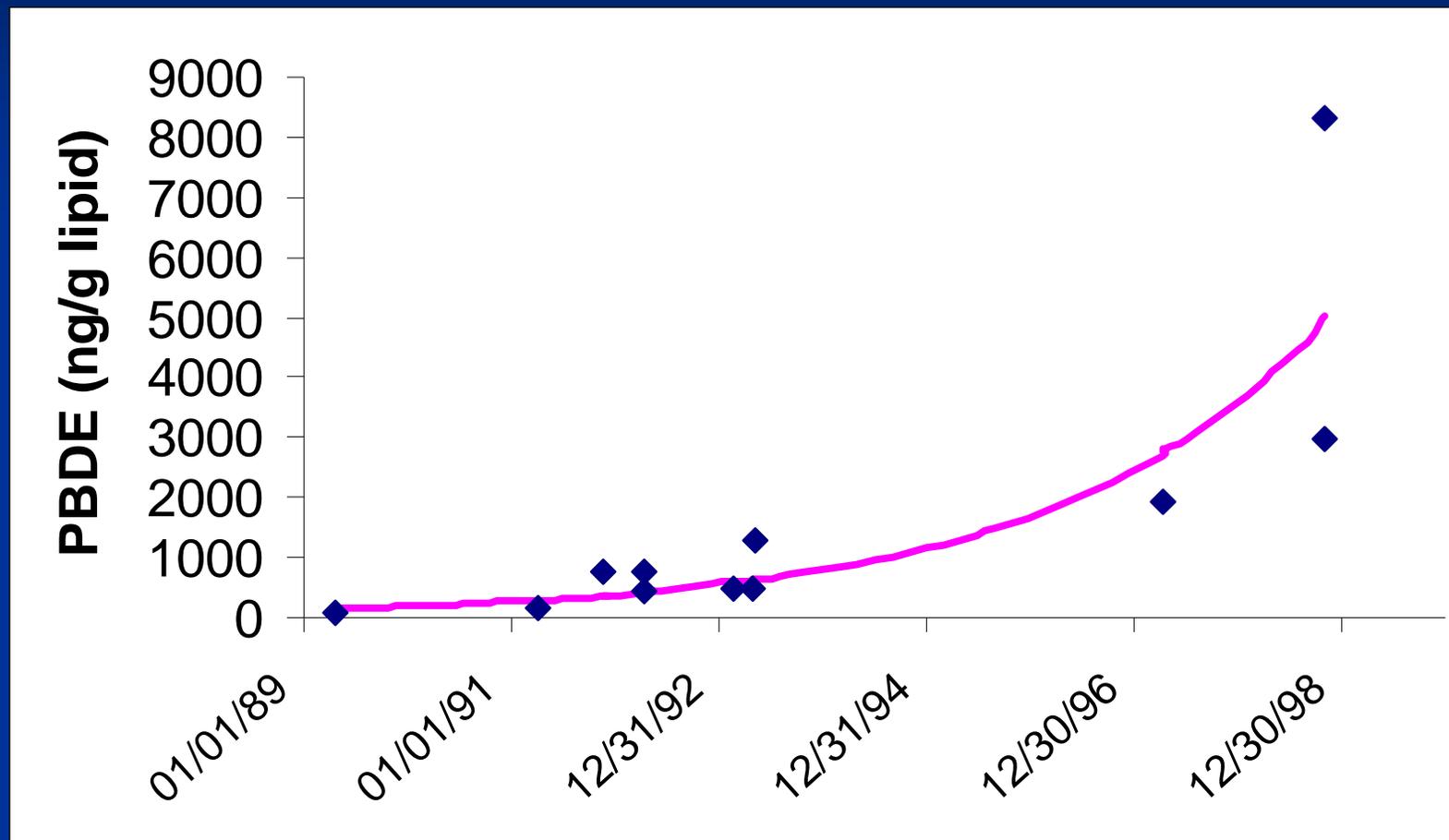
* 86-99% of total PBDE congeners found in human tissues are present in this product.

Basis for Concern



- Increasing concentrations of BFRs (mainly PBDEs) in the environment, humans and wildlife.
- Toxicity concerns, such as
 - endocrine disruption (PBDE, TBBPA, HBCD)
 - dioxin formation (PBDE, TBBPA, HBCD)
 - altered behavior and learning (PBDE)
 - inadequate testing for suspected sensitive endpoints (cancer, brain development, sensitization)

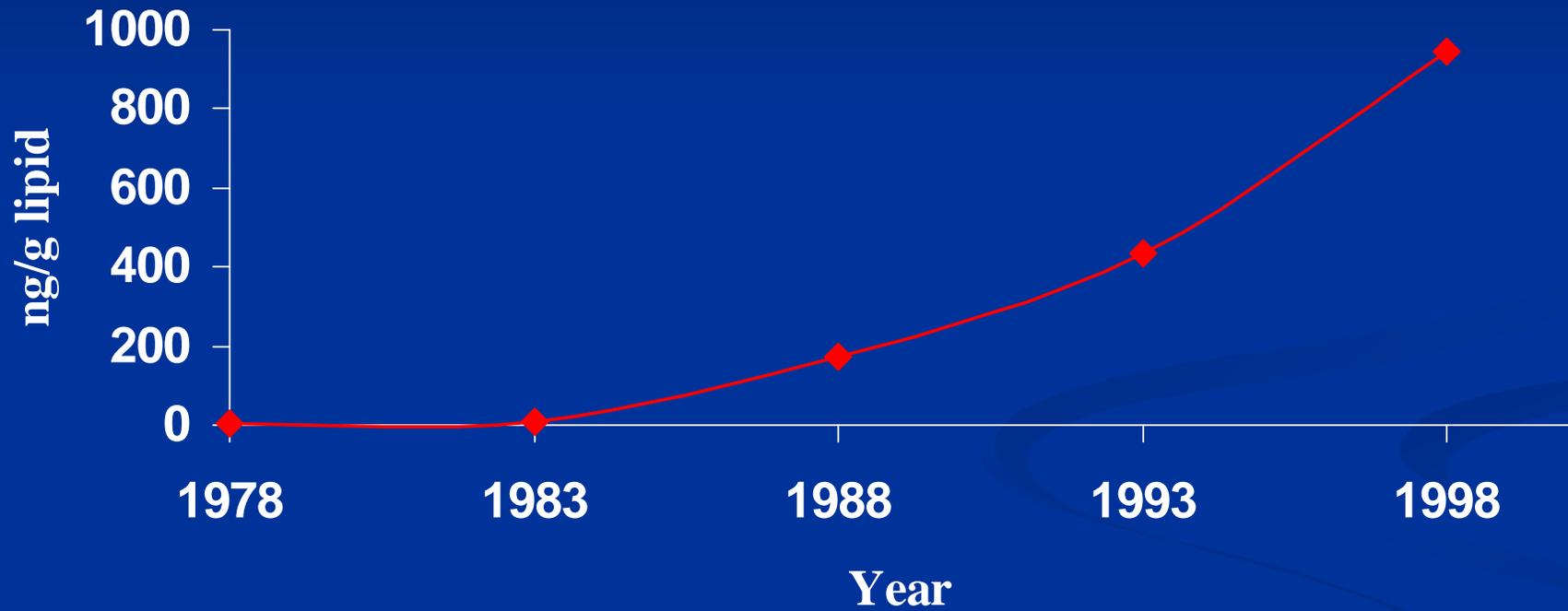
Time-trend: PBDEs in Blubber of California Seals (She et al., 2002)



N=11

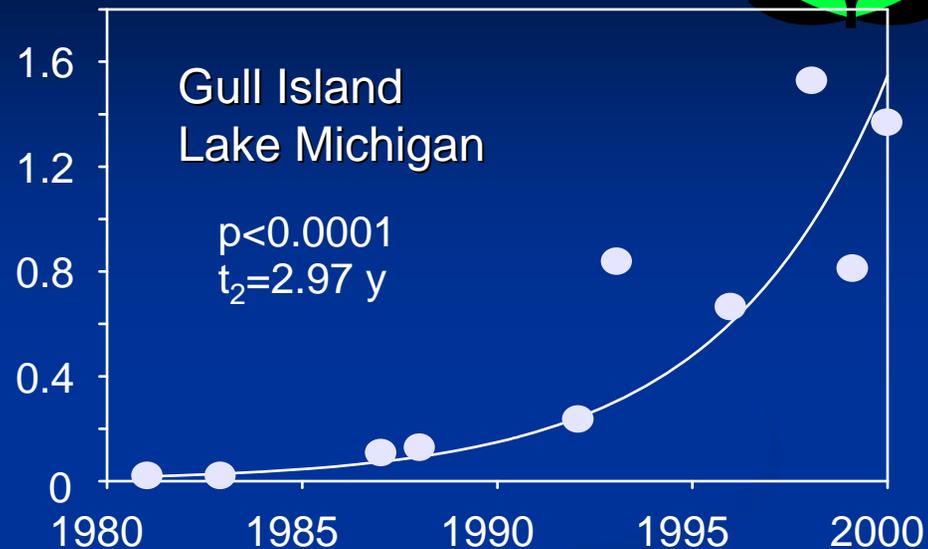
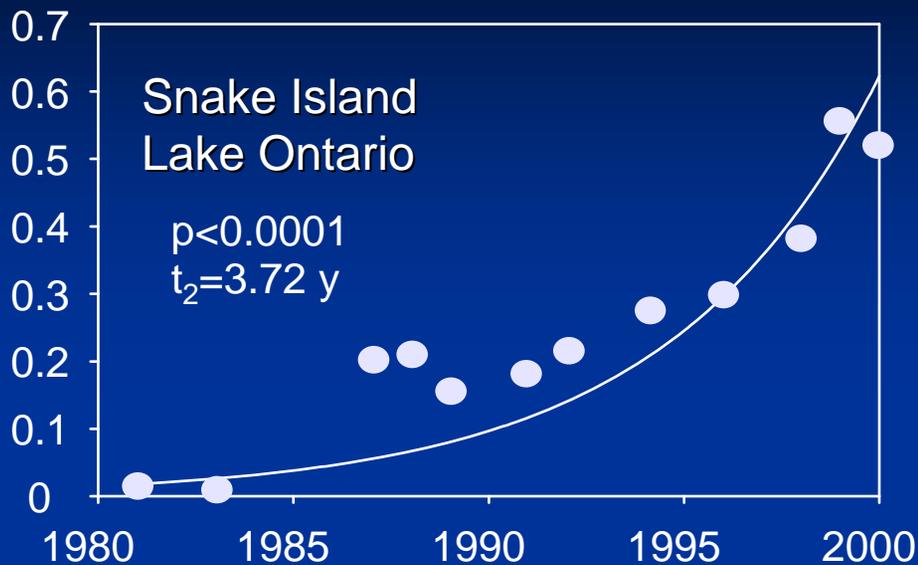


PBDEs in Lake Ontario Trout (1978 - 1998)

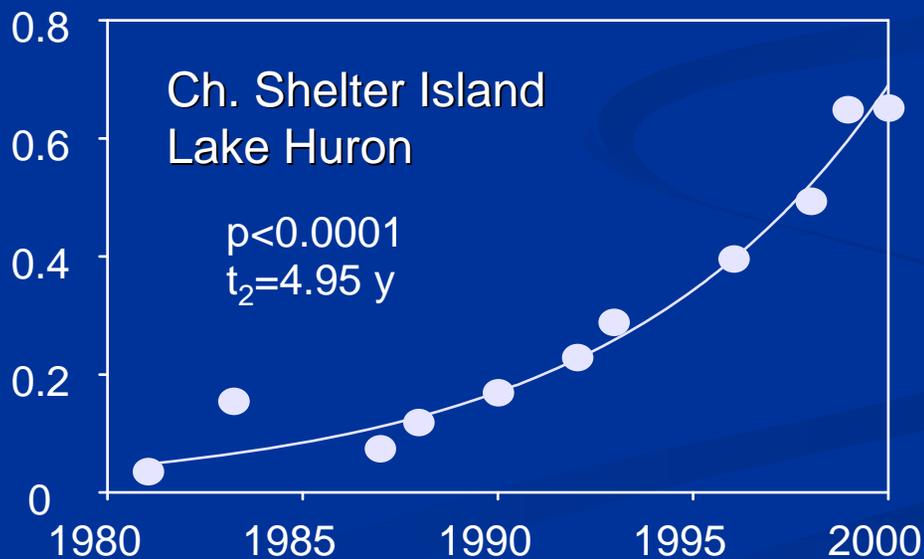


Luross et al. (2000)

PBDEs in Herring Gull Eggs - Great Lakes



µg/g fresh wt.



Graph from
M. Alaei
(2002)

PBDEs and Other BFRs are Released in the Environment

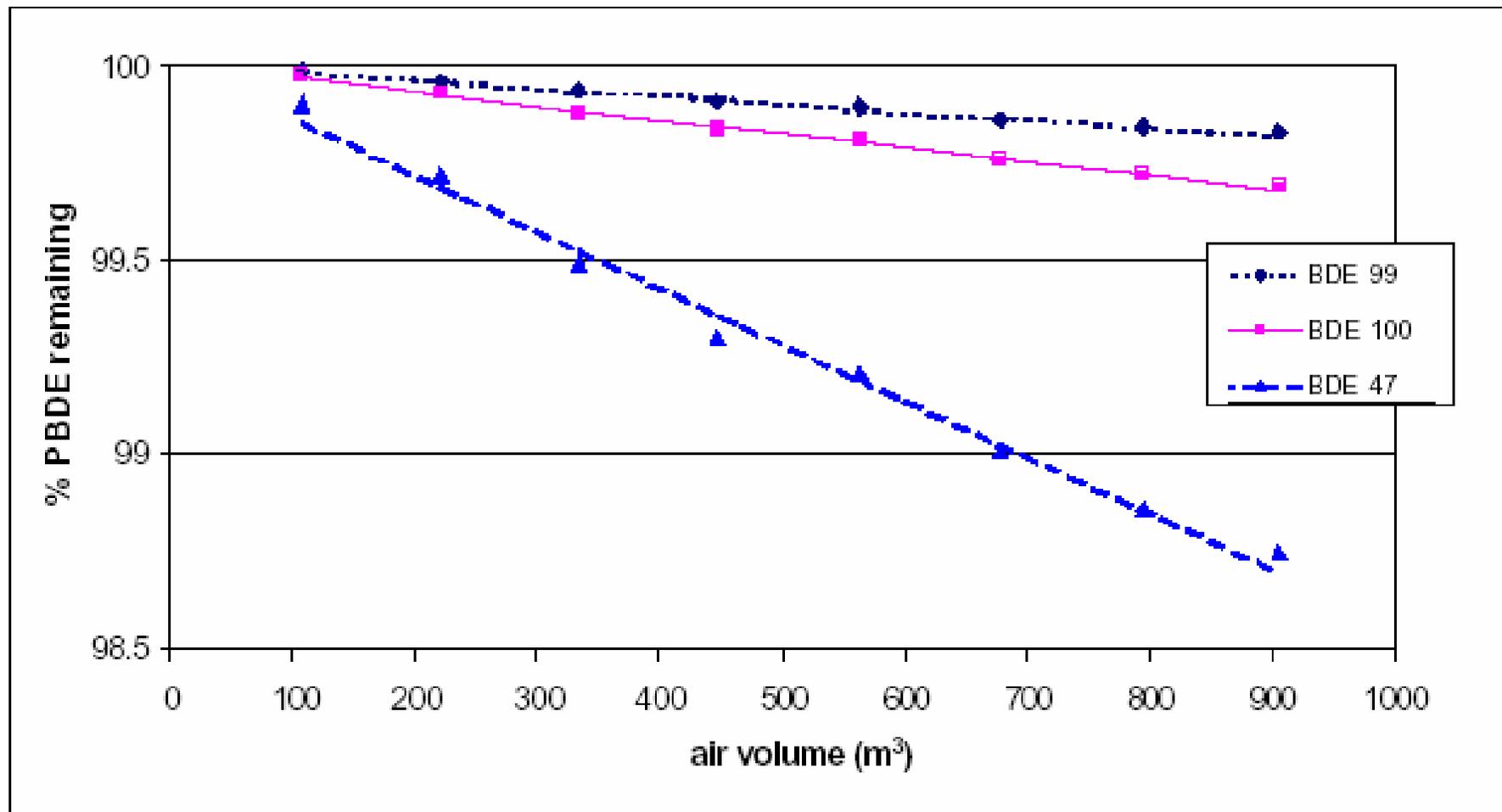


- How? – not well understood
 - “Billions” of point sources
- PBDEs measured in
 - Indoor and outdoor air, office dust
 - Rivers and lakes
 - Sewage sludge
 - Foods
 - Biota (terrestrial and marine mammals, fish, humans)

PBDEs Volatilize from Foam



Figure 1. Release of the principal PBDE congeners from penta-treated PUF foam.



Risk Summary



- “Margin of exposure” for PBDEs appears to be low.
 - Better data are needed to compare tissue concentrations of PBDEs in humans versus rodents.
 - Uncertainty in rodent versus human tests for neurodevelopmental changes
 - Levels of PBDEs rising in the population

Tom McDonald, M.P.H., PhD, California Office
of Environmental Health Hazard Assessment

Risk Summary



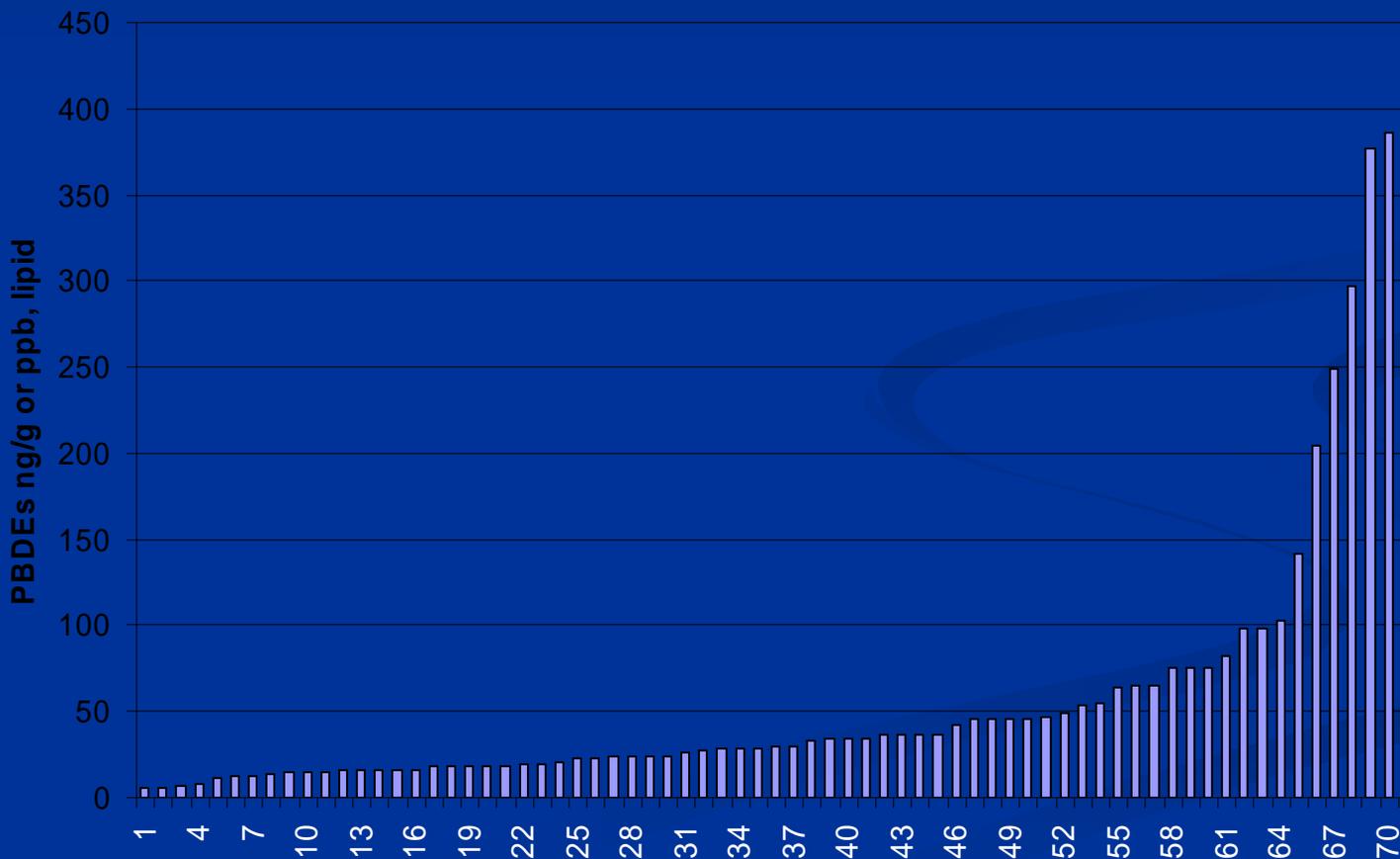
- “Margin of exposure” for PBDEs appears to be low.
 - Rats start to see impaired male fertility and ovary cell development at 230 ppb, behavioral change at 660 ppb and dampened thyroid activity at 5,700 ppb.

Tom McDonald, M.P.H., PhD, California Office
of Environmental Health Hazard Assessment

U.S. Human milk PBDE levels, 2005, N=62.



ng/g or ppb, lipid. Mean: 66 ppb, median: 32 ppb, minimum: 6.2 ppb, maximum: 418 ppb.



Risk Summary (continued)



- An even greater concern: PBDEs and PCBs may be working together.

- PCB levels usually higher than PBDEs
- Co-administration of PCB and PBDE caused
 - additive effects on altering behavior in mice
 - additive effects on thyroid hormone disruption
- Same effects on some mechanistic endpoints
- **PBDEs/PCB co-exposures significantly reduce the “margin” between exposure and potential health effects.**

Tom McDonald, M.P.H., PhD, California Office
of Environmental Health Hazard Assessment

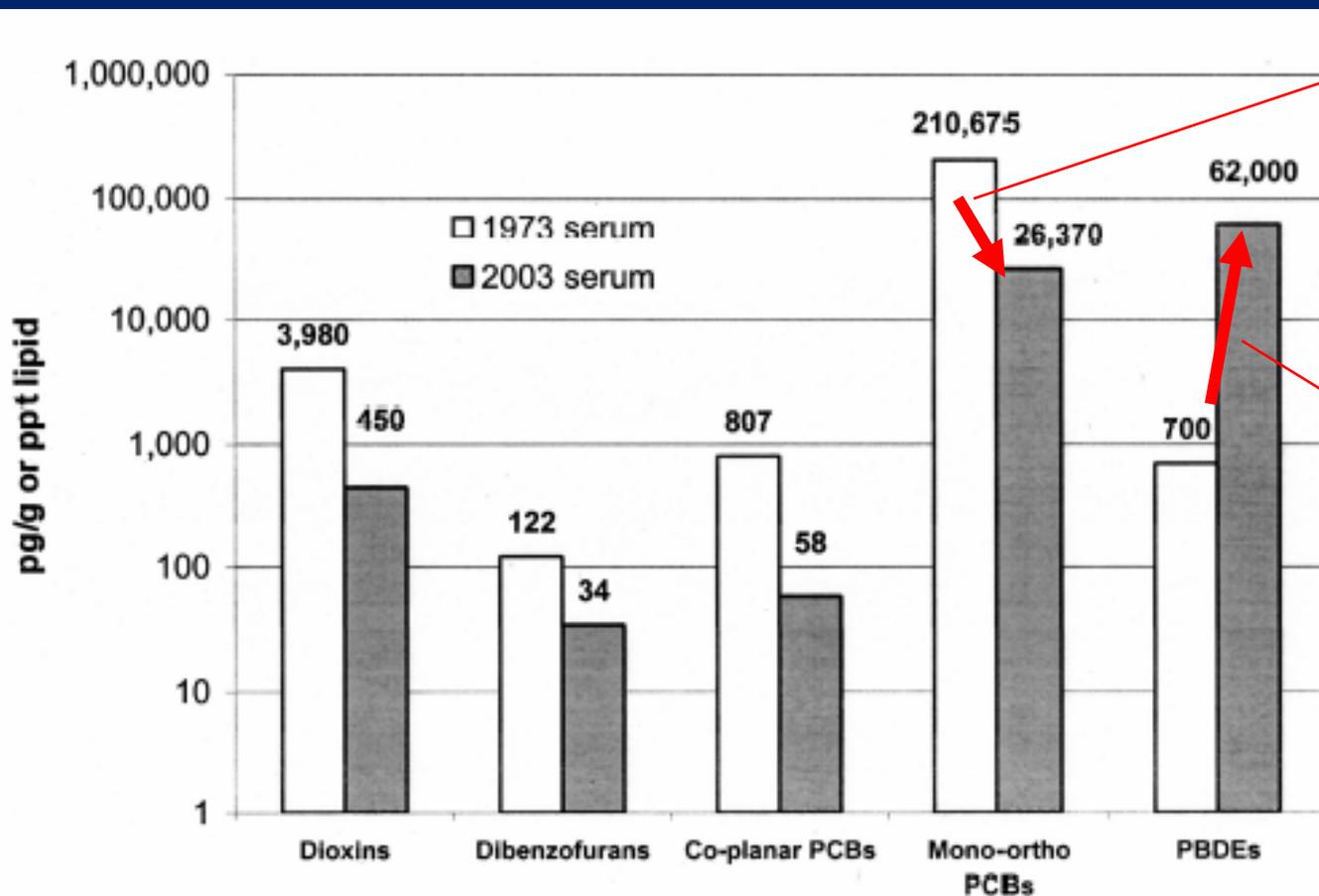
Effects of PCBs on Intelligence



- The 11% of the children whose mothers had the highest exposures now have IQs 6.2 points lower than average.

Jacobson and Jacobson (1996)

Levels of Persistent Toxins in U.S. Serum 1973-2003

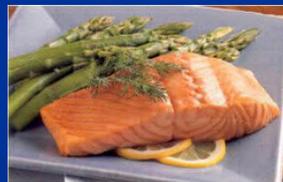
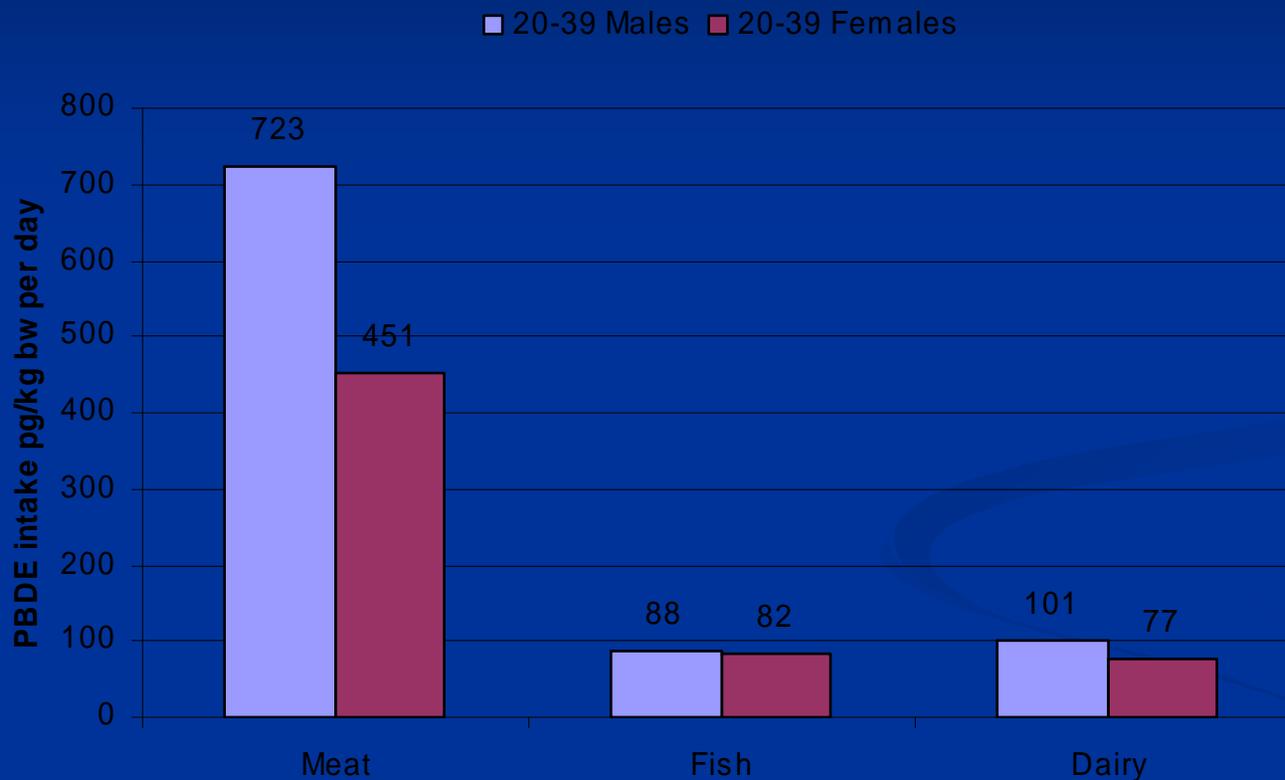


Down by factor of 10

Up by factor of 100

Fig. 5. Dioxins, dibenzofurans, polychlorinated biphenyls, and polybrominated diphenyl ether levels in pooled U.S. blood, 1973 and 2003 (ng/g or lipid ppb).

Daily U.S. adult PBDE intake estimate



What are Trends in Regulation of PBDEs



- Regulations and Bans Appearing
- Increased Reporting Requirements and Monitoring Programs
- Interest in PBDE-free Purchasing



Trends in PBDE Regulations



- EU countries banning certain compounds
 - Penta and OctaBDE by 8/15/04
 - DecaBDE exempted from ROHS in 2005
- U.S. EPA
 - Required testing and reporting (VCCEP)
 - EPA/Great Lakes Voluntary Phase-out of Penta and Octa BDE effective 12/31/04. SNUR to follow.
- State Bans
 - CA (Penta and Octa by 2006), Hawaii, Maine, Washington, others

Voluntary Actions



- Several European Eco-labels prohibit BFRs in electronics (Nordic Swan, TCO)
- American groups promoting purchasing BFR-free products
- Industry Responding
 - NEC
 - Fujitsu
 - Sony
 - Toshiba

EPA Region IX PBDE Activities



2002

2003

2004

2005

2006

R9 Roundtables → CA Ban → GL Phaseout

BFR Workgroup → EPA Project Plan

Furniture Partnership → Alternatives Analysis

Furniture Flame Retardancy Partnership



 United States Environmental Protection Agency

Volume 1

**Furniture Flame Retardancy Partnership:
Environmental Profiles of Chemical Flame-Retardant
Alternatives for Low-Density Polyurethane Foam**



www.epa.gov/dfe

Scorched Foam



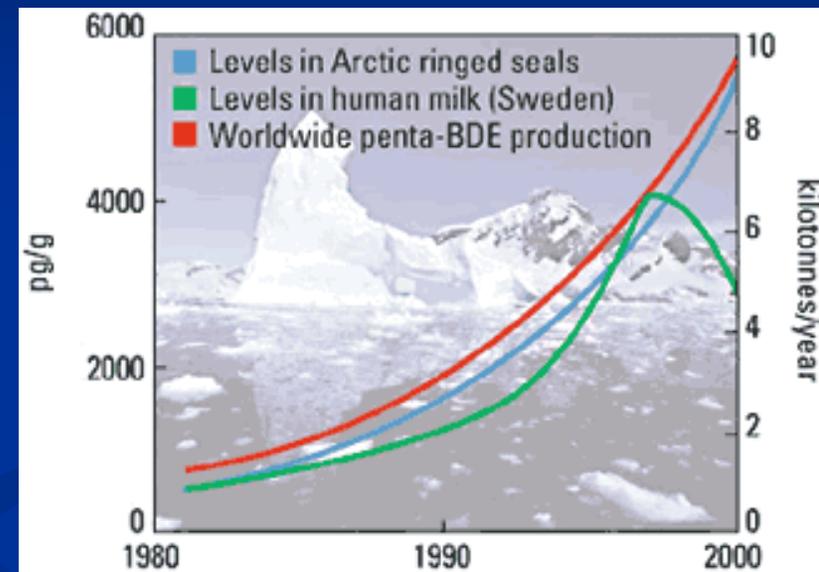
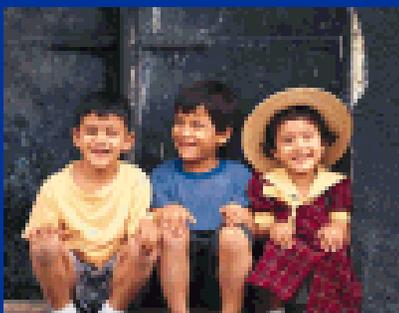
What to Look for in the Future



- Following the phase out of penta- and octa-, tracking PBDE levels in wildlife and humans

When will levels start to decline?

- BFR-free Products



Memoryfoam website January, 2004



The Highest Exposed

ng/g or ppb, lipid. Mean: 66 ppb, median: 32 ppb, minimum: 6.2 ppb, maximum: 418 ppb.

- Two individuals from New York – May 2005:
 - 4,000 ppb
 - 10,000 ppb (10ppm!)
- The Hammond-Holland Family in Berkeley
 - Mom and Dad around 100ppb
 - Mikeala, age 5 500ppb
 - Rowan, age 2 700ppb
- Breastfeeding estimated to contribute 130ppb per day

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It's In Us All

Flame retardants contaminate everyone but concentrate especially in children

By Douglas Fischer, STAFF WRITER

One year ago, Michele Hammond and her husband, Jeremiah Holland, sat together at their dining room table, contemplating some frightening lab results for their two children.

Their son, Rowan, a rambunctious, towheaded toddler, had some of the highest levels of flame retardants in his blood of anyone measured on Earth.

And their daughter, 5-year-old Mikaela, was close behind.

The question at the time was whether these children were unique: Did something in their home or life lead to such unusual numbers, or might most children have higher-than-expected levels?

It is hard to say, because even today Rowan and Mikaela remain the only two young children in the United States to have been tested for such compounds.

A year later, however, new exposure estimates and more data about these chemicals in our environment make the answer clear: They are not alone.

The science suggests that for this flame retardant, polybrominated diphenyl ethers, or PBDEs, levels in children throughout the United States are higher and possibly much higher than their parents.



Rowan Hammond Holland (right) plays with classmates at his preschool, the New School, in Berkeley earlier this month. (Nick Lammers - STAFF)



View the [multimedia presentation](#) [Flash, 2.2 MB]

And parents, particularly in California, already have the most flame-retardant blood in the world, so high the most-exposed are near levels causing fertility and sexual defects in lab rats, according to one analysis.

Top Listings

CARS RENTALS JOBS HOMES

Loan Agt (Jobs)
COMMUNITY ONE

PLUMBER (Jobs)
MSP PLUMBING CO.

MEDICAL (Jobs)
PLEASANTON CONVALESCENT HOSP.

RESTAURANT (Jobs)
STRIZZI'S RESTAURANT

AUTOBODY (Jobs)
MORGAN ENTERPRISES

HAYWARD (Jobs)
SALES & Prop Mgmt.

NURSING (Jobs)
ST FRANCIS EXTENDED CARE

COURIERS (Jobs)
TRANS-BOX SYSTEMS

ALL LISTINGS

Tales from the Sales
the fine art of buying and selling in the classifieds





Reducing Exposure

- Vacuum with HEPA filter
- Air out the car
- Eat low fat meat and dairy
- Get rid of treated foam